CLAIMS

1. A telemetry system for transmitting an electromagnetic signal within a borehole traversing a formation, the system comprising:

(a) a borehole EM transceiver;

(b) a surface EM transceiver;

(c) a first signal wire with a first end comprising first electrode disposed within said borehole and a second end electrically connected to said surface EM transceiver;and

(d) a second signal wire with a first end comprising a second electrode disposed within said borehole and a second end electrically connected to said surface EM transceiver; wherein

(e) a measure of electric potential is made between said first and said second electrodes thereby forming said signal.

2. The telemetry system of claim 1 wherein said second electrode is disposed on said formation.

3. The telemetry system of claim 1 wherein said first electrode is disposed on an outer surface of a tubular within said borehole.

4. The telemetry system of claim 1 wherein said first and second electrodes are in a plane perpendicular to the major axis of said borehole.

5. The telemetry system of claim 1 wherein said first and said second signal wires are disposed in an annulus between the outer surface of a tubular and the wall of said borehole.

6. The telemetry system of claim 5 wherein said surface EM transceiver is disposed within said annulus.

7. The telemetry system of claim 1 wherein said surface EM transceiver is positioned above earth surface through which said borehole penetrates.

8. The telemetry system of claim 1 wherein said second electrode is radially penetrated into said formation.

9. The telemetry system of claim 1 wherein said first and said second signal wires are configured as a twisted pair.

10. A telemetry system for transmitting an electromagnetic signal within a borehole, the system comprising:

(a) a borehole EM transceiver;

(b) a surface EM transceiver; and

(c) an active field measuring device disposed in an annulus defined by an outer surface of a tubular within said borehole and a wall of said borehole; wherein

(i) said active field measuring device measures an electric field induced by said borehole EM transceiver thereby forming said signal, and

(ii) said signal is transmitted to said surface EM transceiver by at least one signal wire disposed within said annulus.

11. The system of claim 10 wherein said active field measuring device comprises a downhole processor and said signal is processed in said downhole processor prior to transmission to said surface EM transceiver.

12. The system of claim 10 wherein said surface EM transceiver is disposed within said annulus.

13. The system of claim 10 wherein said surface EM transceiver is disposed above earth surface through which said borehole penetrates.

14. A measurement-while-drilling system for measuring a parameter of interest within a borehole, said system comprising:

(a) a downhole assembly comprising a sensor, wherein said downhole assembly is terminated at lower end by a drill bit and at an upper end by a drill string operationally attached to a drilling rig;

(b) an electromagnetic telemetry system for transmitting an electromagnetic signal indicative of a response of said sensor, said telemetry system comprising

(i) a borehole EM transceiver,

(ii) a surface EM transceiver,

(iii) a first signal wire with a first end comprising first electrode disposed within said borehole and a second end electrically connected to said surface EM transceiver,

(iv) a second signal wire with a first end comprising a second electrode disposed within said borehole and electrically connected to formation traversed by said borehole and a second end electrically connected to said surface EM transceiver, wherein

(v) a measure of electric potential is made between said first and said second electrodes thereby forming said signal; and

(c) a processor cooperating with said surface EM transceiver by means of a link to convert said signal into said parameter of interest.

15. The telemetry system of claim 14 wherein said first electrode is disposed on an outer surface of a tubular within said borehole.

16. The telemetry system of claim 14 wherein said first and second electrodes are in a plane perpendicular to the major axis of said borehole.

17. The telemetry system of claim 14 wherein said first and said second signal wires are disposed in an annulus between the outer surface of a tubular and a wall of said borehole.

18. The telemetry system of claim 14 wherein said second electrode is 15a radially penetrated into said formation.

19. The telemetry system of claim 14 wherein said first and said second signal wires are configured as a twisted pair.

20. A measurement-while-drilling system for measuring a parameter of interest in a borehole, said system comprising:

(a) a downhole assembly comprising a sensor, wherein said downhole assembly is terminated at lower end by a drill bit and at an upper end by a drill string operationally attached to a drilling rig;

(b) an electromagnetic telemetry system for transmitting an electromagnetic signal indicative of a response of said sensor, said telemetry system comprising

(i) an active field measuring device disposed in an annulus defined by an outer surface of a tubular and a wall of said borehole; wherein

(ii) said active field measuring device measures an electric field produced by said borehole EM transceiver thereby forming a signal, and

(iii) said signal is transmitted to said surface EM transceiver by at least one signal wire disposed within said annulus; and

(c) a processor cooperating with said surface EM transceiver by means of a link to convert said signal into said parameter of interest.

21. The system of claim 20 wherein said active field measuring device comprises a downhole processor and said signal is processed in said downhole processor prior to transmission to said surface EM transceiver.

22. A method for transmitting an electromagnetic signal within a borehole traversing a formation, the method comprising the steps of:

(a) disposing a borehole EM transceiver within said borehole;

(b) disposing a surface EM transceiver above said borehole EM transceiver;

(c) disposing within said borehole a first signal wire with a first end comprising first electrode and a second end electrically connected to said surface EM transceiver;

(d) disposing within said borehole a second signal wire with a first end comprising a second electrode disposed within said borehole and a second end electrically connected to said surface EM transceiver;

(e) measuring an electric potential between said first and said second electrodes thereby forming said signal; and

(f) transmitting said signal between said surface EM transceiver and said borehole EM transceiver via said first and said second signal wires.

23. The method of claim 22 wherein second electrode is disposed on said formation.

24. The method of claim 22 comprising the additional step of disposing said first electrode on an outer surface of a tubular within said borehole.

25. The method of claim 22 comprising the additional step of disposing said first and second electrodes in a plane perpendicular to the major axis of said borehole.

26. The method of claim 22 comprising the additional step of disposing said first and said second signal wires in an annulus defined by the outer surface of a tubular and a wall of said borehole.

27. The method of claim 22 comprising the additional step of disposing said second electrode within said formation by radially penetrating said formation.

28. The method of claim 26 comprising the additional step of disposing said surface EM transceiver within said annulus.

29. The method of claim 22 comprising the additional step of disposing said surface EM transceiver above earth surface through which said borehole penetrates.

30. The method of claim 22 comprising the additional step of configuring said first and said second signal wires as a twisted pair.

31. A method for transmitting an electromagnetic signal within a borehole, the method comprising:

(a) disposing a borehole EM transceiver within said borehole;

(b) disposing a surface EM transceiver above said borehole EM transceiver;

(c) disposing an active field measuring device an annulus defined by an outer surface of a tubular within said borehole and a wall of said borehole;

(d) measuring with said active field measuring device measures an electric field produced by said borehole EM transceiver thereby forming said signal; and

(e) transmitting said signal to said surface EM transceiver by means of at least one signal wire disposed within said annulus.

32. The method of claim 31 wherein said active field measuring device comprises a downhole processor and said signal is processed in said downhole processor prior to transmission to said surface EM transceiver.

33. The method of claim 31 comprising the additional step of disposing said surface EM transceiver within said annulus.

34. The method of claim 31 comprising the additional step of disposing said surface EM transceiver above earth surface through which said borehole penetrates.

35. A measurement-while-drilling method for measuring a parameter of interest in a borehole, said method comprising:

(a) providing a downhole assembly comprising a sensor, wherein said downhole assembly is terminated at lower end by a drill bit and at an upper end by a drill string operationally attached to a drilling rig;

(b) transmitting a signal indicative of a response of said sensor with a telemetry system comprising

(i) a borehole EM transceiver,

(ii) a surface EM transceiver,

(iii) a first signal wire with a first end comprising first electrode disposed within said borehole and a second end electrically connected to said surface EM transceiver, and

(iv) a second signal wire with a first end comprising a second electrode electrically connected to formation traversed by said borehole and a second end electrically connected to said surface EM transceiver;

(c) measuring an electric potential between said first and said second electrodes thereby forming said signal; and

(d) converting said signal into said parameter of interest with a processor cooperating with said surface EM transceiver by means of a link.

36. The method of claim 35 comprising the additional step of disposing said first electrode on an outer surface of a tubular within said borehole.

37. The method of claim 35 wherein said first and second electrodes are in a plane perpendicular to the major axis of said borehole.

38. The method of claim 35 comprising the additional step of disposing said first and said second signal wires in an annulus between the outer surface of a tubular and a wall of said borehole.

39. The method of claim 35 comprising the additional step disposing said second electrode within said formation by radially penetrating the formation..

40. The method of claim 35 comprising the additional step of configuring said first and said second signal wires as a twisted pair.

41. A measurement-while-drilling method for measuring a parameter of interest in a borehole, said method comprising:

(a) providing a downhole assembly comprising a sensor, wherein said downhole assembly is terminated at lower end by a drill bit and at an upper end by a drill string operationally attached to a drilling rig;

(b) transmitting a signal indicative of a response of said sensor with a telemetry system comprising,

(i) an active field measuring device disposed in an annulus defined by an outer surface of a tubular and a wall of said borehole, wherein

(ii) said active field measuring device responds to an electric field generated by said borehole EM transceiver thereby forming said signal, and

(iii) said signal is transmitted to said surface EM transceiver by at least one signal wire disposed within said annulus; and

(c) converting said signal into said parameter of interest with a processor cooperating with said surface EM transceiver by means of a link, wherein

(d) said at least one signal wire reduce attenuation of said signal transmitted between said surface EM transceiver and said borehole EM transceiver.

42. The method of claim 41 wherein said active field measuring device comprises a downhole processor and said signal is processed in said downhole processor prior to transmission to said surface EM transceiver.

43. The method of claim 41 comprising the additional step of disposing said surface EM transceiver within said annulus.

44. The method of claim 41 comprising the additional step of disposing said surface EM transceiver above earth surface through which said borehole penetrates.